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United States Department of Agriculture.

OFFICE OF THE SECRETARY—CIRCULAR NO. 11.

METHODS AND BENEFITS OF GROWING SUGAR BEETS.

INTRODUCTION.

Nothing can be more apparent than the evolution of system and the improvement of methods taking place in the beet-sugar sections of the country. The influence of this industry is affecting the industrial and social status of every community possessing a sugar factory. In the neighborhoods surrounding our older factories this change is observed by travelers and tourists from other parts.

The growing of sugar beets is started first as an experiment on the part of the farmers; next it becomes a sort of a rotation crop, and finally becomes leading staple crop, and its influence becomes dominant in the agriculture of the community.

A sugar factory is built up in a hitherto quiet agricultural community and it becomes an intensifier of all interests. Gradually the whole farming community is drawn into the work of producing its supply of beets. Every programme of the farm is eventually based upon the accomplishment of this object. The years roll on, and the children born into this agricultural community become adepts in the work. They have absorbed every detail of the relation of this industry to themselves. It is their bread and butter, their employment, their constant subject of business discussion; its fortunes are theirs. It is the inspiration of their lives Every advantage it presents is known and appreciated by them.

In order to get some glimpse of the future in many districts of the United States, it is only necessary to take a journey through France, Germany, or Russia, where immense areas of land are devoted chiefly to the cultivation of sugar beets.

THE SUPPLY OF BEETS.

It will not be out of place here to call attention also to the strong retroactive influence this condition of things will exert in this country on the factories themselves in the future. In its inception every sugar

factory has to start under a great many unfavorable circumstances, and has to overcome many obstacles. Most of these are due to the present lack of centralization, such as we find in the beet-sugar districts of Europe. For instance, if for any reason the season has been unfavorable in Germany or France, there is no tendency on the part of the growers to become discouraged, abandon the crop, or try something else the following year. They have witnessed the results of the beet growing year in and year out. They know its benefits compared with those of any other crop available under the conditions. In the sugar-beet districts of this country, if a farmer should try beet growing one year and for some reason score a failure, or partial failure, he is very liable to decide that sugar beets are a poor crop, and to change to something else. This means lack of stability in the supply for the factory and a constant solicitation on the part of the management to secure even a moderate supply of beets.

The farmer as a rule is conservative. He is slow to take up a new crop, and slow to abandon it once he has become familiar with it. There is much to be gained when this conservatism shall operate in favor of sugar beets instead of against them. This will in fact eliminate the greatest obstacle the beet-sugar factory has to meet at present. Every sugar factory now established had to begin this battle for supremacy of the sugar beet in its farming district. To secure a supply of beets is the thing of greatest importance.

There are now 56 factories in the United States, each of which is working more or less strenuously in this contest. With many of them it is a drawn conflict. Many others have gotten beyond the danger line, and are on the high road to permanent success in the beet-sugar industry. Some of them are struggling along with the balance more against them than in their favor. A few have succumbed—have been dismantled or retired from the field.

Is it not apparent that these factories will have achieved a great victory, that they will be working under a much more favorable order of things, when sugar-beet raising becomes a fixed and not an experimental industry? Imagine the difference between the pioneer work described above and that in a community in which the sugar-beet crop has long been the dominant factor in the social and industrial life!

Some of the factors on which depends the development of the beet-sugar industry in this country are presented in the following paragraphs.

SELECTION OF THE SOIL.

The first requisite in successful sugar-beet growing is a suitable soil. This will become more evident to the farmer as he proceeds with the crop. There is no doubt that the beet crop makes a heavy draft upon the soil, and should be classed in this respect with corn, potatoes,

and tobacco. It quite often happens that the farmer mistakenly selects a piece of ground for growing sugar beets not well adapted to growing other crops, and not considered productive. If a soil is light and sandy, it should be avoided for the beet crop, unless, through rotation of crops and fertilization, it has been brought up to the right condition for sustaining such crops as corn and potatoes.

The question is often asked: "Do sugar beets exhaust the soil?" The proper answer to this question is, that any crop will exhaust the soil if planted continuously and nothing is done to renew it. Sugar beets will not exhaust the soil more than other heavy crops if the right methods are pursued. It should be the aim of every farmer growing sugar beets to make a profit out of them the same as with any other crop; therefore, he should be careful in the selection of land for growing them. If a piece of land is not adapted to general cropping, avoid it for sugar beets. Put upon it something better adapted to it, and operate, if possible, in such a way as to make it productive. If it is wet and sour, drain it. If light, put it in grass or build it up with legumes in rotation with light crops and liberal applications of barnyard manure. At least do not try to reclaim it with sugar beets. They are not a good reclaimer.

Beets are an expensive crop at the best, and should be put upon lands offering the best opportunities for good yields. It takes 6 to 7 tons of beets per acre to pay the actual cost of production, and it is the tonnage of beets over and above this amount that yields the profit. So it can readily be seen that poor land should be planted to something whose production is not so expensive. On poor land sugar beets are liable to produce a loss, either in a low sugar content and purity, or small tonnage of beets per acre.

A prospective sugar-beet farmer has a great many facilities at the present time for posting himself in this respect. Sugar-beet growing is becoming quite general throughout the various parts of the United States, and it is quite probable that he can find some one in his neighborhood who has practical knowledge of the subject. If not, the factories are constantly publishing literature containing directions for growing beets, selection of land, and treatment after they are planted. The experiment stations of the various States are publishing bulletins and distributing them free of charge, containing much matter upon these subjects. Every sugar factory has an agriculturist for the express purpose of instructing the farmers in the proper methods of growing sugar beets, the selection of lands, and how to treat the different lands in growing this crop. The Department of Agriculture is publishing a great deal of material upon the subject of the beet-sugar industry. All of these publications are available and free for the information of the farmer engaging in sugar-beet growing.

Most farms contain different kinds of soil which are in different

states of availability for cropping, though some of them are equally good in all parts. The land selected for sugar beets must be fertile and susceptible to fine pulverization. The surface and subsoil must be of such a nature as to be easily penetrated by the taproots, laterals, and rootlets.

The land should be as free as possible from the seeds of weeds and grass. However, these can be overcome by sufficient attention and labor.

ROTATION OF CROPS.

A system of crop rotation should be adopted. The best rotation, as a rule, is the one that permits of fall plowing prior to the season of planting beets. This is especially true in sections of the country where the soil is subject to freezing. The proper rotation, however, depends upon the location of the farm and the kind of crops generally produced in that section.

Sugar beets have been grown on the same land successively and successfully for a series of years, sometimes as high as five, but it goes without saying that this is not the proper method. Usually the results of such farming are bad. It should be the aim of the farmer to thoroughly fertilize the ground during the cycle of rotation. This is usually considered most favorable for beets if done a year or two prior to planting the crop. Always start with the best land, and bring other lands up to a better state through rotation, cultivation, and fertilization before planting the beets. In this way beets eventually increase the productiveness of the whole farm.

PREPARING THE LAND FOR THE SEED.

Preparing the soil properly for growing sugar beets is another important feature, and comes next to the selection of the soil itself. We must consider all the different important steps necessary in growing a beet crop. A failure in anyone of them, or a lax or loose method, may result in disaster or loss. Having determined to grow the crop, no pains should be spared in doing it right. Everything depends upon doing each part thoroughly and faithfully. The preparation of the seed bed proceeds differently under different conditions of soil and climate.

There are two things, however, that apply generally: (1) Deep plowing, and (2) minute pulverization by surface harrowing. Often it is necessary to subsoil while turning the land with a stirring plow. Many instances are reported where this has not appeared beneficial, many instances where it has appeared to be actually harmful, and many more where it has been absolutely necessary. Where winter freezing obtains, fall plowing is usually preferable, if possible. In the first place it catches the summer and fall crop of weeds and grass and turns

them under, thus eliminating some of the difficulties of cultivation during the growing of the plants. In the next place, fall rains or irrigation dampen the soil, and the upheaval through freezing mellows it, and makes available certain of its elements of fertility.

After the land is plowed it should be thoroughly pulverized. This may be accomplished in several ways—by harrowing, dragging, planking, and rolling. Whatever local system is used most successfully in accomplishing this purpose is the most desirable. The idea is to pulverize the soil, and this is an important matter. The sugar beet is, in its early stages, a tender plant, and, while the soil should be fine, at the same time it should be moist and in such a condition as to thoroughly compact about the beet ball, filling in the convolutions of its outer parts. This is desirable, because it enables the ball to absorb moisture, which promotes the germination of the seed. If the surface is left in a lumpy or cloddy condition, many of the seeds remain in open spaces allowing free circulation of the air, and, instead of being moistened, they are dried up and the germs are killed.

Sugar-beet growing is garden culture on a large scale. It might be stated in a general way that whatever is applicable in gardening in preparing seed beds, and in the care necessary to germinate the seeds and sustain the plants in their aftergrowth, will apply also to sugar beets. Most of the success of this plant during its growing season will depend upon the proper condition of the ground at the time of planting.

QUALITY AND SOURCE OF OUR SEED SUPPLY.

The proper selection of the seed is the first requisite in planting. At present most of our beet seed is imported from Germany and France. As with other commodities, there are a few standard varieties, the quality of which is well known. These standard varieties are also in the hands of responsible and established firms. Very serious mistakes are sometimes made in the selection of seed. The entire crop for one new factory in this country was one season produced from seed of a low quality and with consequences that were serious and far-reaching.

No one can tell much about the quality of seed by looking at it. A farmer can test the seed by germinating a certain number of seeds between two dampened blotters kept warm and moist. He can observe what percentage germinates. As each seed or ball has from one to five germs, there should not be less than 150 sprouts from 100 balls. If, in addition, 80 per cent of the balls produce as much as one sprout each, the seed can be considered good from the standpoint of vitality.

The best method to pursue with relation to seed is to consult the nearest reliable source of information, such as a factory or an experiment station which is making tests.

The standard test usually applied to sugar-beet seed is the one called the "Magdeburg test," which is as follows:

The seed should not have in dirt or refuse over 3 per cent.
The moisture of seed should be not to exceed 15 per cent.
In 5 days 100 balls should produce not less than 100 sprouts.
In 7 days 100 balls should produce not less than 125 sprouts.
In 14 days 100 balls should produce not less than 150 sprouts.
In 14 days 1 pound of seed should produce not less than 31,818 sprouts.
In 14 days not less than 80 per cent of the balls should sprout.

METHOD OF PRODUCING SUGAR-BEET SEED.

Beet-seed production can not be carried on successfully in a small way. It requires large capital and extensive equipment, and covers a period of from three to five years. No farmer should think of trying to produce seed for use in growing beets for factory purposes. The method of producing the beet seed grown in Europe—that which we import—is practically as follows:

First physical examination.—The grower of the seed starts with a quantity of high-grade seed. This is planted and the resultant beets before they are harvested are scanned for the characteristics of high quality as indicated by the size, shape, color, quantity, texture, stem, and placement of the leaves. By these characteristics beets are selected denoting high quality. Some mode is then used to designate the individual beets which have been selected for segregating at the harvest.

Second physical examination.—When the beets are harvested, those whose superior quality was indicated by the leaves are scanned for characteristics of quality shown in the root itself, as indicated by size, shape, color, etc.

Chemical test.—In the following spring the beets which passed the two physical tests are taken out of the silo and given a chemical test. This consists in taking out a small portion of each beet, which is analyzed for sugar content and purity. This finishes the examination, and the ones in which high quality has been indicated throughout the tests are selected for "mother beets."

Mother beets.—These mother beets are planted on very carefully prepared land in rows and on areas 3 feet by 3 feet, different varieties being isolated. Each beet has a number or designation that follows it throughout its test and growth.

Mother beet seed.—The resultant crop of seed from these selected mothers is known as the mother-beet seed and is the seed from which is produced a new crop of mothers for beginning another series of examinations and selections, such as I have just described.

"*Elite*" *seed.*—Most of this mother-beet seed, however, is used in the production of commercial beet seed. It is planted in rows 12 inches apart and after the beets come up they are thinned to 24 plants to the foot. This will, of course, produce very small beets, about

three-fourths to 1 inch in diameter. These small beets (called Stecklinger) are siloed in the fall. In the spring they are set out in areas 3 feet by 3 feet.

These beets produce the crop of seed that goes into the market, furnishing the seed for the farmers who grow the beets for the factories. It is known as "elite" seed, or "A" seed. It is the best seed procurable for growing beets.

Second-class seed.—It appears that there is "shoddy" in every kind of business. There is no exception in beet seed. The responsible beet-seed growers of Europe furnish this standard "A" or "elite" seed to those who call for it. It is much more expensive, but it is the seed that should be used in all cases. The closer akin the seed is to the selected mothers the higher will be the quality of the beets. There is another class of growers, however, who plant out this "elite" seed and grow another crop of small mother beets similar to the first. These are planted the following spring, producing a crop of second-class stecklinger, which are planted out, producing seed the same as in the case of the first-class stecklinger. This removes this second-class seed two generations from the original selected mothers. As without constant selection there is a great tendency in beets to degenerate in sugar and purity, it must be apparent that this second-class seed is very much inferior to the "elite." Much of it, however, reaches this country and is planted, producing many of our crops of beets.

Third-class seed.—There is another class of "growers" (so called) who do not produce seed at all, but who assemble seed much the same as is done in the general seed business in this country. This second-class seed is bought up, mixed with old seed on hand, and disposed of under the advertisement of some "extensive beet-seed grower." It must appear evident that a great deal of care should be exercised, as the selection of beet seed is vitally important to the factories of this country.

HOME-GROWN SEED.

For several years we have been producing seed in a limited way in various parts of the country, especially in California, Utah, Michigan, and Washington. Some of these American growers make no chemical tests, doing everything by physical selection, while others have made a beginning of chemically analyzing mother beets. The indications are that we shall grow a very high quality of seed when this matter is given as careful attention as obtains in Europe, where most of the seed used by us is produced. Even with the methods now used by these American growers, seed is produced for our growers of beets that in quality compares very favorably with the beet seed imported from Europe. This home-grown seed appears particularly strong in germination. This is especially important, as vitality is the main

feature in securing a stand of beets. A beet-seed grower in the State of Washington handed the writer a memorandum of two tests made on the germination of seed produced by him, in one of which 96 balls out of 100 germinated, and in the other 98 balls out of 100. Results of tests made at different factories of the germination of imported seed show that from 53 to 80 balls in 100 germinate. It seems that the imported beet seed from which we grow the beets for our factories runs generally no higher than this.

The beets produced from home-grown seed also show high sugar contents. Below are the results of 185 analyses of beets grown from seed produced in the State of Washington. These tests were made at the chemical department of the State Agricultural College at Pullman, Wash., October 10, 1903:

Sugar contents of beets from home-grown seed.

	Per cent.
8 beets, average sugar in beet	17.26
15 beets, average sugar in beet	18.48
52 beets, average sugar in beet	19.38
53 beets, average sugar in beet	20.30
39 beets, average sugar in beet	21.32
16 beets, average sugar in beet	22.22
1 beet, average sugar in beet	23.00
1 beet, average sugar in beet	24.00
185	20.21
162 beets, average sugar in beet	21.69
110 beets, average sugar in beet	22.15

GERMINATION TESTS OF SUGAR-BEET SEED.

Some germination tests of sugar-beet seed have recently been made by Mr. E. Brown, botanist in charge of the seed laboratory, Bureau of Plant Industry, United States Department of Agriculture. The results so far secured are shown in the following table:

Germination tests of sugar-beet seed by Bureau of Plant Industry.

Test No.	Name of grower.	Name of variety.	Duration of test in days.	Sprouts from 100 balls.	Per cent of balls giving sprouts.	Sprouts from 2½ pounds
12708	Dippe Bros. (foreign)	"Dieppe"	6	159	63.5	79,400
			14	175	71	80,600
12735	Vilmorin-Andrieux Co. (foreign).	Vilmorin Improved	6	152.5	76	82,160
			14	160	77.5	(a)
12756	Utah Sugar Co. (home grown)	Lehi, Utah	6	94.5	44.5	66,800
			14	102.5	51.5	71,200
12790	Agnew Bros. (home grown)	Agnew California	6	90	43	40,400
			14	97	48.5	41,800
12838	No record of grower (foreign).	Hoerning, improved Kleinwanzlebener.	6	197.5	81	81,200
			14	214	87.5	89,600

a Not given.

Germination tests of sugar-beet seed by Bureau of Plant Industry—Continued.

Test No.	Name of grower.	Name of variety.	Duration of test in days.	Sprouts from 100 balls.	Per cent of balls giving sprouts.	Sprouts from 2½ pounds.
13007	E. H. Morrison (home grown)	Kleinwanzlebener Original.	6	198.5	93.5	96,800
			14	203	97.5	98,600
16981	Rebettke & Gieseke (foreign)	do	6	182.5	80.5	64,000
			14	198	85	71,800
16982	Christ Mohrenweiser (foreign)	do	6	160.5	77	77,400
			14	169	79	88,800
16984	Schreiber & Sohne (foreign)	Elite	6	125.5	74	69,000
			14	145.5	81	76,400
16983	Otto Breunstedt (foreign)	do	6	145	68	76,200
			14	163.5	74	86,200
16985	W. Ramdohr (foreign)	do	6	63	37.75	29,600
			14	90	49	45,200
16986	M. Knauer (foreign)	do	6	168	75.5	79,800
			14	186	81.5	88,800
16989	Alma Sugar Co. (home-grown)	No. 1	6	161.5	74.5	83,600
			14	180	80	91,600
16990	do	No. 2	6	161	85.8	71,400
			14	179	89.5	80,000
18235	E. H. Morrison (home-grown)	Kleinwanzlebener Original	5	201.5	89.5	89,800
21457	do	do	4	169.5	79.5	92,200

It should be noted that tests Nos. 18235 and 21457 were for five and four days, respectively, and not six and fourteen days, as were all the others.

It will be seen that on six and fourteen day tests the Washington seed grown by Mr. Morrison, with whom the Department is cooperating in sugar-beet seed breeding, excels each of the other seeds in every respect, with the exception of the number of sprouts in fourteen days from the Hoerning seed, and it excels that in every other respect.

POSSIBILITIES OF IMPROVEMENT THROUGH HOME-GROWN SEEDS.

It is believed that the average sugar content of beets in this country can be increased 2 to 3 per cent when we shall have developed a higher strain of beets through home-grown seed. On account of the higher vitality of the germ, these experiments indicate that we shall have a race of beets more vigorous from the start.

In the production of beets for a factory, the vitality of the seed as shown by germination is an important factor. It is the first evidence of the probable yield of the crop that the grower looks for. Everything depends upon the stand. It is desired that a beet shall fill every place in the row provided for it. It is evident that if every third beet is missing, there will be only two-thirds of a stand of plants matured at the harvest. If the rows are 18 inches apart and the beets stand 8 inches apart in the row, there will be 312 beets to the row, and 138⅔ rows to the acre. If every beet is in its place, there will be 43,264 beets to the acre. If these beets average 1 pound, there will be 43,264 pounds to the acre, equal to 21.63 tons. If the beets average 2 pounds, which is more nearly the usual size, we will have 43.26 tons per acre. This shows the possible tonnage per acre when all conditions are favorable and we have a perfect stand. Vitality of seed is a strong factor in reaching this ideal.

The plants should start out strong, vigorous, and healthful. They must send down their taproots vigorously and send out their laterals quickly; this enables them to entrench themselves early in the soil. Plants are like animals. Vigor in youth promises much for healthful maturity. Strong vitality or germinating power of the seed indicates this early vigor, which will enable the plants to withstand diseases, pests, and drought. The number of sprouting germs in a given number of beet balls and the vigor and rapidity of germination are the tests of this vitality. Home-grown seed has shown a higher germinating power in a shorter time than those selected from ordinary imported seed. From these facts it would appear that we are entitled to anticipate a higher yield of beets from the use of home-grown highly developed beet seed.

The extraction of refined sugar in this country averages 11 per cent or 220 pounds of refined sugar to a ton of beets. The factory pays the farmer for this sugar $2.27 per hundredweight while it is still in the beet. If the factory could extract 13 per cent of sugar on account of our perfecting a strain of beets with higher sugar content and purity through home-grown seed, a ton of beets would yield 40 pounds more sugar, worth at the factory $1.80. This alone would give the factory 36 per cent profit upon the investment of $5 per ton for beets. This seems quite possible. Home-grown seed to-day offers the most encouraging prospect of insuring the future growth and prosperity of the beet-sugar industry. There are two things involved: (1) Vitality of the seed, insuring larger tonnage; and (2) higher sugar content, insuring increased extraction; either one of which will throw the balance of power to the home beet-sugar industry as against sugar produced anywhere else under present conditions. Either the increased tonnage or the greater extraction (the first incident to the greater vitality, the second incident to the higher quality of home-grown seed) should alone be sufficient to insure profits on the cost of sugar production as conditions now stand. Happily the higher tonnage would rebound to the farmer's benefit, while the greater extraction would benefit the factory.

As to the quality, the farmer must depend largely upon the respon sibility of the parties furnishing him the seed, as he does with most other things at which he is not an adept at testing quality. By quality in seed we refer to its germinating power and tendency to produce beets of higher sugar content and purity. The sugar in the beet is so well understood as to need no explanation. By purity is meant the absence of certain other solids aside from sugar, usually found in beets in the form of salts of different kinds. There is a wide range in the amount of these salts found in beets grown in different places and under different circumstances.

It must be understood that originally the sugar beets were vastly dif-

ferent from those of to-day. When they were first used in the manufacture of sugar they were considered of good grade if they contained as high as 6 or 7 per cent of sugar. Purity coefficients running from 70 to 80 were regarded as good. Now the purity of the beets throughout the beet-producing districts of the United States runs from 80 to 96 per cent. The sugar contents of the beets grown around many of our factories, especially in Colorado and the Pacific States, will average throughout the campaign as high as 17 per cent. During the past season I have received reports from many parts of the country—western Kansas, Nebraska, Colorado, and California—of individual beets which have tested as high as 25 per cent of sugar.

The sugar beet of to-day is the creation of the practical scientist. It is one of the best examples we have of plant evolution through human effort. People are generally aware that the highly developed, beautifully formed, and finely veined domestic animals of to-day are simply the result of human intelligence employed in selection and breeding. Certain desirable qualities are noted in an animal, and his race is closely culled for specimens showing these qualities, and these and their progeny are bred for generations for these points, until an ideal specimen is produced. This has been the method of breeding sugar beets. The propagators of this product have greatly increased its content of sugar and its purity through selection and breeding. From the original sugar-beet progenitors, with averages of 6 and 7 per cent sugar, they have progressed to averages of 16 and 17 per cent sugar with a maximum in the United States of 25 per cent.

What the farmer desires in seed is vitality and sugar-producing quality.

PLANTING AND GERMINATION.

The soil being put in right condition, and containing sufficient moisture for germination, the seed should be sown with a beet seeder in rows which are 16 to 20 inches apart, the distance depending on local circumstances and kinds of soil. It is better to use a specially designed beet seeder which is adjustable as regards width of rows and amount of seed per acre. The amount of seed usually required is 15 to 20 pounds per acre. The seeds are dropped quite close together, the regulation of the amount per acre being governed by the proximity of the seeds in the row.

It is usually anticipated that more seeds will germinate and come up than required. This is to insure a stand of beets, which is absolutely essential to the success of the crop. The beet seeder can be adjusted so as to plant from a half inch to an inch and a half in depth, according to the kind of soil and its conditions as regards moisture, warmth, etc. Care should be taken not to plant too deep. Until experience shall have given him a definite idea of his own, the grower

should seek advice regarding the proper depth from some person better posted than himself as to planting sugar beets in his locality.

Some method of compacting the soil around the seed is generally desirable. This is usually accomplished by rolling. The smooth surface left by a roller is objectionable in some localities, for instance, where the soil is sandy and there is much wind, thus drifting the sand against the young beets, cutting them off or injuring them. Under such circumstances the ground is usually "planked." This is accomplished by drawing a platform arrangement made of planks over the soil, which leaves the surface considerably rougher than does the roller.

Care must be used to plant at the right time the same as with any other crop. This must be determined by the moisture in the soil, its temperature, and the weather.

In from seven to ten days, if the soil is warm and moist enough, the beets will begin to make their appearance. The real struggle on the part of the grower for a crop begins at this juncture. There are several kinds of emergencies that may arise at this tender stage of the plant; a frost or a hail storm can do them considerable damage, and they may have to be replanted. In replanting it is not good practice to undertake to reset beets extensively.

This germinating period is the anxious time of the beet grower. A beating rain may crust the surface to such an extent that the beets can not penetrate it. In such cases valuable results may be produced by using a harrow to break up the crust of the surface. At every stage of the crop the beets must be kept clean and cultivation must begin at the earliest possible moment. Sometimes they are cultivated soon after planting. These first cultivations are accomplished with special beet cultivators, which work several rows at a time. These cultivators are adjustable to the width of the rows, and usually have, for the first cultivation, small, loose, sharp knives running parallel with the surface, and designed to cut off the grass and weeds just below the surface.

BUNCHING AND THINNING.

About the time that the beets show the fourth leaf the bunching and thinning process begins. This is necessary to remove the excess of plants. Single plants should be left in the row from 6 to 10 inches apart, depending on the distance between the rows and the kind of soil. The time of thinning is important. If the proper amount of seed has been used there will be a considerable excess of plants, due to the nearness of the seeds to one another. A still further excess results from the fact that each particular seed contains from 1 to 6 germs, all of which are liable to germinate.

It is quite evident that, if all the germs in a single seed grow, we

are liable to have a bunch of several plants, standing very close together, often intertwining and forming a network of rootlets. The longer these plants are allowed to grow in this way the more complex, difficult, and harmful becomes the process of removing the superfluous plants. If this thinning is put off too long it disturbs the position of the plants which are to remain, breaks their tender rootlets, and materially and permanently injures them. Every effort should be made to accomplish this thinning as quickly as possible. A little money spent at this stage proves a very valuable investment in the after stages of the plant. A beet grower should prepare himself beforehand, and be ready to accomplish this work quickly and not allow it to drag along. With the best of intentions and preparations, he is liable to be more or less hampered by rains and other difficulties, but he should not fail to exert his best efforts to get his crop thinned as soon as possible after sufficiently matured for this purpose.

The process is known in the common parlance of the grower as "blocking and thinning." Blocking is accomplished by a person walking along the row with a short-handled hoe, sharp and of sufficient width, cutting out part of the beets so as to leave bunches the proper distance apart for the plants in the row. Thinning is accomplished by a person creeping along on his hands and knees, and with a deft movement of the hands and fingers removing all the plants in the bunch except the one his eye selects as the strongest plant. This all requires agility, attention, and industrious and laborious effort; it is in a sense a kind of cultivation, because all the soil is loosened around the plant, and should be compressed around it again with the hand before going on. Grass or weeds growing around the plants should also be removed.

CULTIVATION.

The methods of cultivation are various. The object sought is the elimination of the grass and weeds, the conservation of moisture, and the loosening of the soil around the plants. Beets must be kept clean. By this term in sugar-beet growing is meant more than in corn growing. It is desired that these beets shall be rich in sugar. The sun and air are the great reagents which accomplish this result in the beets. Weeds and grass must be eliminated from the crop in order that this may be accomplished. Beets are a vigorous crop, and they should have the full sustaining power of the soil, and not divide it with waste plants and weeds.

It has never been the writer's privilege to visit Germany or other beet-producing countries, but he has been very much interested in interviewing well-informed agriculturists of our own country, who have inspected the methods used in the beet fields of Germany, France, and other European countries, and compared them with those preva-

lent here. It seems that there is a wide difference between the methods of beet culture employed there and those employed in this country, and the difference is not in our favor. In Germany a plan is outlined for rotation which involves the manipulation of the land for a series of years. This land is handled in such a way as to bring about the best results during the different years in the cycle of rotation and for the different cycles planned. There cultivation and preparation of beet fields are more like careful gardening. It is granted that this involves some expense. The increased yield, however, and the economy of soil manipulation induced by its better mechanical condition, very much overbalance the expense.

The cultivation of a beet crop should begin the moment the soil is broken up for planting to beets. If the land is broken in the fall, it should be harrowed immediately, possibly rolled. It should be allowed to rest for a while, giving the weed seed time to germinate and come up; then it should be cultivated and harrowed again. In the spring after stirring it should be cultivated and harrowed several times until ready for planting. After planting, it should be gone over with a "weeder" or harrow as soon as the weeds and grass begin to appear. These harrowings, etc., kill weeds, conserve the moisture, and prevent the soil from baking. A cultivator should be brought into requisition at the earliest possible moment, and the services of the "weeder" or harrow continued alternately with the cultivator even after the plants are up. Cultivation should be continuous from the moment the beets come in sight until they become so large that it is impossible to continue.

After the first cultivation the horizontal blades of the cultivator are replaced with elliptical blades, which penetrate the soil 3 to 4 inches and loosen it, making a dust mulch which conserves the moisture in the soil and promotes the growth of the plant. The cultivator is usually drawn by a single horse or mule, and is manipulated by a single laborer, who usually cultivates two or four rows at a time.

It can be seen that this part of the work is not particularly laborious. One man and one horse can cultivate many acres of beets in the course of the season. The number of cultivations given a crop varies according to the exigencies of the case. If it is a dry season, cultivation should be continuous in order to maintain a dust mulch and conserve the moisture. If the beets are excessively weedy, hand hoes should be used. The number of times the beets should be hoed also varies. The crop should be kept absolutely free of weeds; the ground should be kept soft and in good condition. If the land has become foul, the more hoeing the better the results. If the land is fairly clean, but little hoeing will be necessary.

To the average American farmer, accustomed to growing 160 acres of small grain in addition to a large acreage of corn, such an outline

of work as this may seem preposterous. But it is the most logical method conceivable. This assertion will be indorsed by many successful beet growers of this country who are accustomed to beet growing in this or a similar manner. The logic of this method is that the yield and superior quality of the beets will pay all this expense and greatly enhance the profits besides. It must be within the experience of every observing farmer that a good stand of any crop is the first requisite of profit at the harvest. Such a stand depends largely upon a proper preparation of the seed bed. It must be just as patent to him that cultivation with a harrow and cultivator is a great deal cheaper than cultivation with the hoe or by any hand method. It is much easier and cheaper to destroy weeds when they first germinate, or while they are young, than it is after they have become well established in the soil. It is less expensive to cultivate in the manner above described than in the one ordinarily used, which involves hoeing and hand weeding.

To the person accustomed to his 160 acres, this method of cultivation may seem impossible, but he should not plant 160 acres in sugar beets unless he has a large capital and plenty of labor at hand. For an ordinary farmer 10 acres is considerable. For an extensive farmer 25 acres is a large tract of beets. There are farmers who can successfully grow much more. The acreage should be such that it can be gone over many times with the roller, harrow, and cultivator. If proper attention is given at the right time and is continuous, weeds can be kept in subjection with very little use of the hoe or hand work. Cultivation of other crops should teach this. Good judgment and carefully matured plans for the accomplishment of things in the right way in the proper time is of vital importance. When such judgment and such planning are contributed, beet growing resolves itself into a task comparatively easy of execution. If the farmer will use these methods and thin his beets at the proper time before they have become too large, there can be no question of a good yield.

When the leaves of the beets touch those of the adjoining rows their shade becomes so dense that the ground ceases to dry out so quickly and the weeds and grasses are overcome and smothered in the race for existence. Too much insistence can not be made on horse cultivation. Often growers stop cultivation at the critical time for its use, claiming the soil is too dry for cultivation. This is the time when it is most necessary. In fact, cultivation should be constant. Killing weeds is not the only object; conservation of moisture is paramount when the season is dry. Cultivators stir the surface much deeper and more regularly than hoeing. Constant cultivation maintains a dust mulch, breaks up and covers the sources of egress of the moisture, thus holding it in the soil for the plants. Hand hoeing in its place is desirable, but observations have convinced the writer that, in practice in this

country, much of it is unwise and tends to a high cost of production. A proper system of horse cultivation will lead to better results, and at a lower cost. No hand hoeing can ever take the place of the cultivator in conserving moisture.

A proper system of cultivation should greatly cheapen the cost of production of beets and greatly increase the tonnage per acre. In fact, this has been demonstrated often on the farms of successful growers. It is undoubtedly true that to unwise and expensive cultivation is due most of the discouragement in sugar-beet growing wherever it exists. It can be stated as a general rule that our best yields are not accomplished with the highest cost of production. It is common to see yields averaging 15 to 18 tons per acre in fields alongside of which are others yielding only 5 or 6 tons, the beets being grown from the same seed, on the same land, but by a different farmer.

Good judgment is also required in selecting the proper time for planting, when the soil is moist enough and warm enough to thoroughly germinate the seed. Information and advice on all of these points can be obtained from the agricultural superintendents of the sugar factories. The farmer should not follow his own judgment, and then hold the sugar factory responsible for poor results afterwards. His own judgment will be a good guide for him after he has had considerable experience in growing the beets, the same as with other crops. It will then be worth as much to him as anybody else's experience, if not more, because he will understand better the action of his soil with beets after its manipulation for a series of years. Until such a time arrives, he is bound to follow the advice of those especially provided by the factory for that purpose. In fact, as a rule, he should always secure the benefit of the advice and judgment of these factory experts.

HARVESTING.

After the crops have matured, the next work of the grower is the harvesting. The time to harvest is usually indicated by the agriculturist of the sugar factory for which the beets are destined, and notice is given to the grower to deliver his beets to the factory. An expert in sugar-beet growing can easily discern when beets are ripe. The leaves droop and take on a yellow cast. The sooner they are harvested after this the better, as they have reached their maximum of sugar content and purity. Warm fall rains are liable to start a new growth of the beets, causing them to send out a fresh supply of rootlets. This has a tendency to lower the purity and sugar content of the beets. If it is apparent that the crop can not be received at the factory at some time in the near future, the beets should be harvested and siloed. The contract usually provides for following the orders of the factory in this respect, and this is the safest course.

Siloing is performed by taking the beets after they are harvested

and placing them in piles, covering them with dirt to prevent evaporation and freezing, and increasing the dirt covering as the weather grows colder. There are many methods of siloing in use. The usual one consists in piling the beets in long ricks, pyramidal in shape, with a base of about 6 feet and a height of about 4½ feet. If straw, beet leaves, old hay, or anything of the kind is used, it should be placed on the rick after the dirt. If it is placed on the beets before the dirt, it is liable, by the pressure of the dirt, to adhere to the beets. When they reach the factory this litter interferes with the further manipulation of the beets; it clogs the ditches, and some of it still adheres to the beets after they are washed and interferes with the slicing. For several reasons it is undesirable to place straw, beet leaves, or the like on the beets first.

There are many kinds of harvesters in use. A very common kind is a long-shanked plow, similar to the stirring plow, with a long slender share which cuts off the beets about 9 or 10 inches below the surface, the moldboard throwing them over on their side, after which they are picked up. Another very common variety of harvester is an implement in the shape of a plow. Instead of a moldboard it has two shanks, each terminating with a prong like a finger. These are forced through the soil, one on each side of the row of beets at a depth of about 9 or 10 inches. The opening between the two fingers gradually lessens as the beets pass through the space between them until finally the taproots are broken and the beets are lifted 2 or 3 inches from their position in the soil, whence they are easily extracted by a person following the plow.

Topping is a feature of harvesting which consists in removing the crown and leaves of the beet by a single stroke of a knife in the hands of the operator. It is the purpose of this operator to cleave the beet at the sun line, indicated by the discoloring of that part of the beet just above the surface of the soil. After the beets are topped they are thrown into piles or in wagons, or are sacked preparatory to their delivery to the factory.

DELIVERY OF BEETS TO THE FACTORY.

The delivery of the beets is accomplished in several ways. Anywhere within a radius of 10 miles from the factory they can be delivered in wagons. A greater distance than this usually necessitates delivery by railroad. There are different methods of unloading the beets, some special method of dumping being usually employed. This is accomplished in some places by dumps at the factory, on which the wagons are driven and fastened, and the horses being detached, the whole load of beets is then dumped into the bins automatically. In other cases the wagons are prepared with nets lining the boxes. These are taken up by movable derricks or cranes and swung over the

bins, where the nets open and the beets are dropped into the bins. In other places the beets are shoveled out of the wagons in the old-fashioned way with potato shovels or beet shovels.

At other places, where the sugar-beet acreage is grown in different localities at a distance from the factory, special dumps are built near a sidetrack of a railroad at some point in each locality convenient for the surrounding farming districts. Such a dump is elevated and approached by a long incline or tramway, at the lower end of which the beets are weighed, and up which the load is driven onto the dumping platform. The horses are detached, and, by means of the dump, the whole load is precipitated into a car on the sidetrack below. These are very convenient contrivances, and are becoming quite popular in a great many places. They offer convenience in the delivery of beets by the farmer, greatly lessening the cost of delivery, and very much extending the beet-growing area of the factory.

TARE.

Having grown a crop of beets and delivered them to the factory, the next concern of the farmer is weights and measures. There are two methods in use in making payments for beets. One is called the "flat price," by which is meant so much per ton regardless of the sugar content; the other is so much per ton up to a certain per cent of sugar and purity, and an additional amount for each additional per cent. This is called the "sliding scale."

Owing to the adoption of the latter method at many factories, the prices of the beets vary from $4 to $5.50 per ton. In some States bounties are offered on the production of beets and sugar. Sometimes this bounty is divided between the farmer and the factory, and at other times the factories are given so much for each pound of sugar produced, provided they pay the farmer a stipulated sum per ton for the beets. When the beets arrive at the factory a sample lot from each wagonload or carload is taken by the factory, weighed, washed, and rendered free from extraneous matter. The clean beets are then reweighed, and the amount of refuse and dirt in the sample lot is determined. From this is derived the per cent of tare or waste. This method is continued throughout the delivery of the beets from a particular source, or it is continued long enough to determine the average per cent of tare running through each farmer's beets.

Tare has been the bone of contention between the farmers and the factory. It seems that no one has yet hit on a method of determining the tare that inspires confidence and gives satisfaction to all parties concerned. Beets will naturally be more unclean from one kind of soil than from another; beets from a locality where the soil is wet and sticky will not be so clean as those from a locality which is dry. The tare ranges from 2 per cent to 20 per cent and higher. These wide

differences give ground for considerable controversy during every campaign, and the tare question is the skeleton in the closet of every beet-sugar factory. It is noticeable, however, that in factory districts with long experience, farmers are learning considerable about the conditions that affect tare, and are able to give considerably closer estimates on a wagonload of beets than at the beginning; and the tare question is gradually becoming more of a routine matter.

It is astonishing to see the things that will find their way into the refuse pile of a sugar factory through the delivery of beets—dirt, stones, old iron, old guns, pieces of old implements, and every conceivable kind of débris known in the rural districts. When it is considered that the beets are thrown into the conveyances by hand, it is hardly conceivable how these things find their way into the bins of a sugar factory. It does, however, suggest that there are two sides to the tare question, and some stringent method of determining the amount is necessary.

SOIL IMPROVEMENT.

Anyone who has read up on the preparation of the soil and methods of harvesting the beets, or who has given a close study to the subject by personal observation, must be impressed with the permanent improvement rendered the soil by these operations. In addition to subsoiling, the complete stirring given the upper 9 or 10 inches of the soil in the rotation cycle which includes beet growing and the constant pulverization and cultivation which it receives must be very beneficial. If we add to this intensive cultivation systematic intelligent fertilization, the general and permanent benefits to the soil will be still greater and more apparent. Its mechanical condition is such as to produce the best results and its supplies of plant food are more available. It must be evident that such a piece of ground is better adapted to all kinds of cropping, and experience demonstrates that it is.

It is a general observation that a garden carefully worked and managed is the most productive part of a man's lands. This is on account of the extra care in handling it and, as a rule, the fertility artificially put into it. It goes without saying that if all parts of a man's farm could be handled for a series of years the same as his garden, it would be much more productive as a whole. This is what sugar-beet growing accomplishes. It brings the farm under the influence of garden culture, and in addition to this it brings the farmers of the whole community under the influence of better methods of culture. The tendency is for all the farmers to use better methods and secure better results with all crops.

Good results are just as effective in teaching a farmer as in any other business. When doing things a certain way results in large

profits, the farmer is disposed to repeat the operation. In order to procure a good crop of corn, potatoes, or any other cultivated field crop, it is not really necessary that the field should be absolutely clean. They may be well cultivated and kept ordinarily clean during the growing season, and still a good yield may be secured. But yield is not the only thing under consideration with sugar beets; they must be pure, and high in sugar, and clean cultivation is vitally necessary in securing this end.

THE QUESTION OF FERTILIZING.

Methods of fertilizing the soil for the beet crop are largely on trial in this country. That some fertilization is desirable goes without saying, but in practice very little fertilizer is used. It is necessary, therefore, to emphasize this question here. We have been so accustomed to growing all kinds of crops without fertilizers, reclaiming wild lands and continuing them in cultivation and cropping without any reenforcement, that this question has not come home to us as seriously as it has to the people of some older countries. Even if we possess abundant virgin fertility in our best lands, it will only be temporary at most; we are simply drawing on the future. The sooner we begin some systematic system of fertilizing, the better it will be for the soil.

In the older beet-growing countries of Europe, where plans are arranged ahead for the manipulation of the farms for a series of years, fertilization is one of the things most carefully considered. We are very little accustomed in the greater part of this country to the use of commercial fertilizers. In fact, we are not as much inclined that way as we should be or as we will be in years to come.

No farmer should be advised to abandon other crops in order to grow beets; in fact, under a proper theory of farming, such a thing would be impossible. The farmer should grow beets for two purposes: (1) To improve his farm for other crops; and (2) for the good profit there is in producing them. This simply involves the introduction of beets in rotation with other crops. Every farmer should have a plan for the manipulation of his farm for several years in advance. He should balance his stock interests with his crop returns. He is accustomed to growing certain staple crops adapted to his locality. He has done so for some time. He will continue to do so in future. But there is no reason why he should not broaden his plan if he has an opportunity to introduce a new crop which will increase his profits and improve his land. If a sugar factory is located in his vicinity, sugar beets should be introduced into the crop rotation. Probably the main crops have been hay, small grain, corn, etc. In a proper rotation with beets these follow each other in a logical manner from field to field.

If the farmer has properly balanced stock raising against his crop production he will be able to retire from the business of selling grain, confine himself to that of feeding his stock for beef, pork, poultry, butter, cheese, and eggs. This enables him to improve his soils with barnyard manure; in addition it enables him to introduce into the rotation the growing of leguminous plants—the clovers, stock peas, alfalfa, etc. These legumes store in the soil nitrogenous elements required by the grains, and in addition, after a few years, he is enabled in the fall to plow under the second growth of the green crop of clover or peas, and this serves as a valuable fertilizer.

The sugar beet should not be the rival of other crops, but should be their ally in logical cooperation on the farm. We need more careful attention to systematic rotation and fertilization.

One of the fixed charges of cropping in the old countries, especially in the sugar-beet districts, is for fertilizer. In Germany sugar beets are grown on lands worth from $200 to $800 per acre. In a cycle of rotation it costs to fertilize the land from $12 to $25 per acre. Crop earnings there have to be distributed upon such high values of land and fertilization that the people of this country possess a real advantage in this respect in the growing of sugar beets in competition with the farmers of those old countries. A sugar-beet crop is one that will justify the investment in fertilizer.

The methods and systems of fertilization are so various and so dependent upon the character of the soil that it is hard to outline any particular one. The requirements of the soil are like those of animals. They can not all be fed alike. There is a lack of some of the elements of plant food in some soils, and an overabundance of other elements present in both the available and nonavailable state. Fertilizers promote plant life directly, and some indirectly by breaking up compounds and freeing elements of plant nutrition which enter into other available compounds.

Soils need a balancing up of the things needful. This is especially true of the soils of the mountain States and the Pacific coast. The deficiency is best supplied by the introduction of commercial fertilizers. Many of our soils are lacking in humus; they may be rich in mineral plant foods, while at the same time they are poor in mechanical structure. Such soils need to be reenforced by barnyard manure and decaying vegetable matter. Without humus, they dry out and become hard and sterile. Moisture is the agent of solution and circulation, the solvent and common carrier of plant food.

Many soils are deficient in nitrogen, which is supplied both through fertilizer and decaying vegetable and animal matter. Barnyard manure offers a ready means for fertilizing the soil, and one which every farmer can employ. Much has been said and written upon this subject, and, with a common accord, favorable to its use. There has been con-

siderable difference of opinion, however, as to the time and methods of its application for beets. I think much of this disagreement is due to the different requirements of the various soils. Probably barnyard manure is good for all kinds of soil on which sugar beets are grown. As to the time of its application, no suggestion is offered here, except that the farmer should experiment with his soil, study the action of similar soils, and follow his best judgment. Any farmer can largely increase his supply of barnyard manure by a methodical effort. I wish to call attention to the helpfulness of a sugar factory in this particular. Through the pulp produced by it, and the beet leaves and beet tops left in the fields, the sugar factory makes possible a large increase in the number of animals kept on the farm. These by-products afford abundant good forage and stimulate animal production.

The farmer takes a load of beets to the factory and takes home a load of pulp. He gathers his beet leaves or stores them or mixes them with pulp in a silo made for that purpose. Both the pulp and the leaves are good for young animals, fattening animals, and dairy cows. The barnyard manure should be carefully preserved and taken back to the land, increasing the humus and supplying nitrogen and other plant foods. The sugar factory has extracted the sugar, which is not a part of the soil's fertility. Assuming that he returns all of the manure resulting from feeding the pulp from his beets and the beet leaves of the crop, he has returned to the soil again all the fertility appropriated by the beets except that assimilated by the animals. The farmer has intensified the productiveness of his lands and increased the profits of cropping. Every city or town affords a supply of barnyard manure. The citizens are glad to get rid of it. They will give it away, and sometimes they will even pay for its removal. When a farmer takes a ton of beets to the factory he receives only a half ton of pulp in return. He will be able to bring home half as many tons of pulp as he delivers tons of beets. But he need not return empty-handed; he can return half the time loaded with barnyard manure and distribute it on his farm. Thus, he can haul a load from as well as to the factory, largely reducing the net cost of delivering the beets. Thoughtful, progressive, and successful farmers claim that a special trip, for the average distance the farmers haul beets to the factory, made for the sole purpose of procuring manure from the towns of the vicinity, is highly profitable. If this be true, in case he can return to the farm with a good load of manure after unloading his beets, it virtually costs the farmer nothing to deliver a load of beets to the factory.

In regard to the advisability of manuring a plat of ground used in growing sugar beets the same year they are planted, the results of some experiments conducted by the State experiment station at Geneva, N. Y., are introduced. These experiments were conducted for the fol-

lowing purposes: (1) Testing the results on the quality of beets grown on land to which stable manure was applied in the spring prior to the crop; (2) testing the quality of the beets in comparison with beets grown on land receiving no manure; (3) testing beets grown on land receiving commercial fertilizer, compared with those grown on land receiving stable manure. On the plats receiving the commercial fertilizer, 1,000 pounds per acre was used; on plats receiving barnyard manure, 40,000 to 80,000 pounds per acre was used. In either case beets gave better results with barnyard manure.

In growing beets it has been generally believed that it is bad practice to apply fertilizers, especially barnyard manure, in the spring of the year of cropping. These experiments seem to show the reverse of this proposition.

In nearly all of the experiments the manure was applied at the rate of 20 tons per acre in the spring before planting the beets.

In the experiments of 1898 the plats which received no manure yielded a very little over 10 tons of beets per acre, while those manured yielded nearly 15 tons per acre, and the beets were higher in percentage of sugar and coefficient of purity.

In 1899 the plats unmanured yielded nearly 8 tons per acre, while the plats which received 20 tons of manure per acre yielded from 11 to 12 tons per acre, and the beets were again superior in sugar content and purity.

In 1900 the manured plats yielded nearly 21 tons per acre, but how much of this large yield was due to the manure could not be estimated, as no check plats were grown.

In 1901, the plats without manure yielded 12½ tons per acre, while plats receiving 40 tons of manure per acre yielded 18½ tons of beets per acre. In this case the beets on the manured plats were slightly inferior in sugar content and purity, owing doubtless to the use of an excessive quantity of manure.

Experiments with commercial fertilizer were conducted at the same time. The fertilizer used was a mixture containing 5 per cent of nitrogen, 6.7 per cent of phosphoric acid, and 7.5 per cent of potash. Different quantities per acre were used. The largest yields were secured from plats receiving 1,500 pounds per acre, but the yields were only a little less when 1,000 pounds per acre was used. In all cases the fertilized plats yielded much more heavily than the unfertilized, and the beets were higher in sugar content and purity.

A comparison of the results secured with 20 tons of stable manure per acre and those secured with 1,000 or 1,500 pounds of the commercial fertilizer shows that the manured plats yielded a higher tonnage on an average, and that the sugar contents and purity coefficients of the beets averaged higher.

On the whole, the results are decidedly favorable to the use of com-

mercial fertilizers with sugar beets, and still more favorable to the use of barnyard manure.

A HOME MARKET.

It is well understood by all farmers that a home market for their produce is very much better than one far distant. The cost of transportation is saved, and they are largely the beneficiaries. Every community is aware of the local benefits incident to the establishment of a manufacturing industry or anything which has a tendency to increase the population to any considerable extent. Merchants and business men of every city give considerable attention to this subject. Every advantage accruing to the merchant or business man accrues also to the farmer. In the case of a sugar factory the farmer enjoys the lager share of the advantages.

Each sugar factory requires from 200 to 400 laborers. These must all be supplied with produce from the gardens, fields, dairies, poultry yards, orchards, feed yards, etc. A similar demand affects the business of the merchant, the banker, and local business men in all other lines. It has been estimated that several towns have been actually increased in two or three years to the extent of one-third or one-half their population, entirely on account of the additional business and opportunities caused by the location of a sugar factory.

CROP SECURITY.

The element of hazard has its consideration in beet growing, as well as in other crops. There is probably no business in which money is invested and labor expended that is not more or less affected by the hazards of the enterprise. This is true of farming. Domestic animals have their diseases; grains, fruits, and vegetables are all more or less subject to the effects of frost, high winds, beating rains, destructive storms, hail, cold weather, plant diseases, insects, and drought. All these cause more or less anxiety to the farmer.

In deciding what crops to grow the amount of hazard is probably as important a consideration as anything else. With the beet crop the farmer's anxiety is confined to a shorter period. This is the time of germination and the first two or three weeks of the plantlets' life; after that beets may be considered as hardy as any other field crop, if not more so. Once the thinning is over, and the beets have had an opportunity to adjust themselves after this disturbing process, sugar beets are a pretty safe crop as compared with any other, in the face of the above contingencies.

Hail may disrobe it of its leaves, but others will appear, while a crop of grain once beaten down is liable to be a total loss. As to moisture, its greatest danger lies in the growth of weeds and grass in case the rains are excessive and continuous, but this is true of most

other cultivated crops. The beets respond readily when they are once freed from grass and weeds. They shade the ground rapidly and soon completely, and are great helps in their own preservation from these things.

The taproot and its laterals grow down into the ground and follow up the retreating moisture strata under dry conditions. Sometimes these taproots will be found as slender threads 12 to 13 feet below the surface. Supported in this way, they stand drought better than most plants which keep all their roots near the surface.

Another adjustable feature of the sugar beet is that, while, if dry weather prevails, it may not mature so large, it is likely to store a larger percentage of sugar in comparison with one grown in more moist ground. If a farmer's contract with the factory is based upon the amount of sugar which the beets contain, he makes up in extra sugar what he loses in weight of beets. His values tend to adjust themselves. An illustration of this occurred at one of the sugar factories which contracts with the farmers to pay on the sliding scale. The season was very dry; the sugar beets were small. The farmers were greatly disappointed until the crop was delivered. It was then found that the extra money received on account of the higher sugar content of the beets had practically made up for the loss in tonnage. Attention has been called many times in these reports to the self-sustaining powers of sugar beets in the presence of a drought, in comparison with other crops growing under the same conditions.

There is an assurance in the price that the farmer is to receive for his beets; this is fixed at the beginning; he has no hazards of fluctuating markets; he does not even study the reports to see what his market is. He has it at home, uninfluenced by any circumstances.

BUSINESS COOPERATION.

Attention should be called to the business opportunity presented by the sugar-beet crop. There is hardly a factory in the United States whose supply of beets is produced entirely in its vicinity. Towns 50 to 75 miles away, located on a line of railway running to the factory, can encourage sugar-beet production in their vicinity and reap a profit.

Many of these places do not have the facilities for establishing a factory, although they possess first-class facilities for growing sugar beets. Business men in such places are not as a rule entirely absorbed in their particular lines of business. They are looking for other investments in which they can make a reasonable profit.

Last year at Fremont, Nebr., the business men banded together for the purpose of growing sugar beets, organized a company, capitalized it, hired a competent beet grower for a manager, rented a tract of land, purchased implements, grew beets for a factory at some distance, and realized a dividend of 25 per cent over and above the cost,

with implements sufficient on hand and in repair to repeat the operation the following year.

Such organizations are made for different purposes. At Fremont the organization was formed with a view to encouraging the establishment of a factory at that place, the main object being to demonstrate that sugar beets could be grown at a profit by the farmer. In demonstrating this they also demonstrated that it was a practical proposition from a business standpoint for business men to organize and capitalize simply to grow sugar beets. In what other investment is a man liable to realize so large a profit as that mentioned above?

Here is an example set by the business men of Valparaiso, Nebr., during the past two years. It was conceived here that something should be done to employ the time of the idle labor, of which there was considerable around the town, during the cropping season. The beet-sugar industry was looked into and an organization was effected; lands were rented near the town and sugar beets were grown; everybody was offered employment that wished it; merchants largely took stock in the enterprise purely to create the opportunity for the employment of labor.

In this case, because the business was new and untried, and for several other reasons, the enterprise was not highly profitable, but it was highly satisfactory to the merchants conducting it in employing the labor of the town, increasing their sales of goods, and promoting collections of back accounts on their books. From this standpoint it was considered a great success, and the business will be continued and enlarged. Incidentally, it was a boon to the town, and, if only expenses were paid, the project was successful. Prosperity and idleness can not both exist in the same place. The same idea could be put in practice in hundreds of places throughout the country.

Such an organization of merchants at a local trading point should put up sufficient capital to buy the implements—seeders, cultivators, and harvesters—rent them to the farmers, provide a competent agriculturist to oversee the work, and bring in labor to do the work; and for repayment of the sums thus invested the crop should be pledged and the money should be returned at harvest.

Suppose such an organization should raise sufficient money, in addition to this, to rent a thousand acres of land in the near vicinity of the town, hire the idle labor, grow beets, and sell them to the factory. This would require a capitalization of say $10,000; this would meet about one-third the expenses, but would be sufficient to carry the crop to the market. If only 500 acres of land were employed, a capitalization of $5,000 would be required. This money is to be invested in a project that brings back the principal with good profit, opens up a large demand for labor, and pours into the private accounts of the investors and laborers of that locality considerable money each season, all of

which enters into the local business, enhances the profits of the merchants, pays the debts of the community, and produces prosperous times generally.

Let us examine what the possibilities of such a project are: The rent of the land (1,000 acres at $5 an acre) would be $5,000. The rent of such lands for ordinary purposes would be $2.50 to $3. The increase in rent value to the farmer is therefore $2 per acre. Ten tons of beets per acre in a beet-growing section, rightly superintended, is a small average. At this rate the yield would be 10,000 tons of beets, whose value at $5 per ton would be $50,000. Can anyone fail to appreciate the influence of the receipt of $50,000 annually in a small community surrounding a town of, say, 1,000 inhabitants? It would swell the volume of business of all kinds; it would enhance the value of real estate and increase the rental values throughout the district.

Now to proceed with the calculation: It would cost $30,000 to grow these beets, largely paid out for labor and expenditures in the local community. This leaves a clear profit of $20,000, which would pay back the original capital of $10,000 and leave $10,000 in the hands of the organization for carrying on the project another year, with implements on hand and everything in readiness. This estimate is based on the most reasonable probabilities, both as to cost of production and as to tonnage per acre. It shows conclusively that the only thing required of a small town in an agricultural district, accessible to a sugar factory, is sufficient energy to start the ball rolling in order to completely revolutionize business.

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Approved:
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WASHINGTON, D. C., *March 29, 1904.*

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